

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Jonathan J. Wierer Jr., Michael R. Krames, Mihail M. Sigalas  
Assignee: Lumileds Lighting U.S., LLC  
Title: Photonic Crystal Light Emitting Device  
Serial No.: 10/691,026 Filing Date: October 21, 2003  
Examiner: Sara W. Crane Group Art Unit: 2811  
Docket No.: LUM-03-03-02

San Jose, California  
February 1, 2005

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Respectfully submitted,



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PTO/SB/08A (08-03)

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Substitute for form 1449/PTO

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**

(Use as many sheets as necessary)

Sheet 1 of 3

**Complete if Known**

Application Number	10/691,026
Filing Date	October 21, 2003
First Named Inventor	Jonathan J. Wierer Jr.
Art Unit	2811
Examiner Name	Sara W. Crane
Attorney Docket Number	LUM-03-03-02

U. S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code <sup>2</sup> (if known)			
		US- 5,779,924	7-14-1998	Krames et al.	
		US- 2004/0016936 A1	1-29-2004	Tanaka et al.	
		US- 2003/0141507 A1	7-31-2003	Krames et al.	
		US- 6,307,218 B1	10-23-01	Steigerwald et al.	
		US- 6,363,096	3-26-2002	Dodabalapur et al.	
		US- 6,335,548	1-1-2002	Roberts et al.	
		US- 6,156,581	12-5-2000	Vaudo et al.	
		US- 6,071,795	6-6-2000	Cheung et al.	
		US- 6,559,075 B1	5-6-2003	Kelly et al.	
		US- 2003/0222263 A1	12-4-2003	Choi	
		US- 5,955,749	9-21-1999	Joannopoulos et al.	
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FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup> -Number <sup>4</sup> -Kind Code <sup>5</sup> (if known)				
		JP 07176788	7-1995	Kurahashi		
		EP 1 385 215 A2	1-28-2004	Nichia Corp.		

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Sheet 2 of 3	Attorney Docket Number	LUM-03-03-02	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T <sup>2</sup>
		J.J. WIERER et al., "InGaN/GaN quantum-well heterostructure light-emitting diodes employing photonic crystal structures," Applied Physics Letters, Vol. 84, No. 19, May 10, 2004, pp. 3885-3887.	
		LEE et al., "Modified spontaneous emission from a two-dimensional photonic bandgap crystal slab," J. Opt. Soc. Am. B, Vol. 17, No. 8, August 2000, pp. 1438-1442.	
		BORODITSKY et al., "Surface recombination measurements on III-V candidate materials for nanostructure light-emitting diodes," Journal of Applied Physics, Vol. 87, No. 7, April 1, 2000, pp. 3497-3504.	
		BORODITSKY et al., "Light extraction from optically pumped light-emitting diode by thin-slab photonic crystals," Applied Physics Letters, Vol. 75, No. 8, August 23, 1999, pp. 1036-1038.	
		WINDISCH et al., "Light-emitting diodes with 31% external quantum efficiency by outcoupling of lateral waveguide modes," Applied Physics Letters, Vol. 74, NO. 16, April 19, 1999, pp. 2256-2258.	
		XU et al., "Finite-difference time-domain calculation of spontaneous emission lifetime in a microcavity," J. Opt. Soc. Am. B, Vol. 16, No. 3, March, 1999, pp. 465-474.	
		HWANG et al., "Spontaneous emission rate of an electric dipole in a general microcavity," Physical Review B, Vol. 60, No. 7, August 15, 1999, pp. 4688-4695.	
		FAN et al., "High Extraction Efficiency of Spontaneous Emission from Slabs of Photonic Crystals," Physical Review Letters, Vol. 78, No. 17, April 28, 1997, pp. 3294-3297.	
		Vuckovic et al., "Surface Plasmon Enhanced Light Emitting Diode," Journal of Quantum Electronics, Vol. 36, 2000, pp. 1-13.	
		Tredicucci et al., "Single-mode surface-plasmon laser," Applied Physics Letters, Vol. 76, No. 16, April 17, 2000, pp. 2164-2166.	

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		Imada et al., "Coherent two-dimensional lasing action in surface-emitting laser with triangular-lattice photonic crystal structure," Applied Physics Letters, Vol. 75, No. 3, July 19, 1999, pp. 316-318.	
		Pottage et al., "Vertical-cavity surface-emitting resonances in photonic crystal films," J. Opt. Soc. Am. A, Vol. 18, No. 2, February 2001, pp. 442-447.	
		TIWARI, S., "Compound Semiconductor Device Physics," Academic Press, Inc., San Diego, CA, 1992, pp. 182-186.	
		G.B. STRINGFELLOW and M. GEORGE CRAWFORD, eds., "High Brightness Light Emitting Diodes," Academic Press, Inc., 1997, Chapter5, "AlGaInP Light-Emitting Diodes," by F.A. KISH and R.M. FLETCHER, pp. 149-170.	
		P.A. KOHL, "Photoelectrochemical etching of semiconductors", IBM J. Res. Develop., Vol. 42, No. 5, 5 September 1998, pp. 629-637.	
		Chen-Fu CHU et al., "Comparison of p-Side Down and p-Side Up GaN Light-Emitting Diodes Fabricated by Laser Lift-Off", Jpn. J. Appl. Phys., Vol. 42 (2003), Part 2, NO. 2B, 15 February 2003, pp. L147-L150.	
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		T. FUJII et al., "Increase in the extraction efficiency of GaN-based light-emitting diodes via surface roughening", Applied Physics Letters, Vol. 84, No. 6, 9 February 2004, pp. 855-857.	
		Y.-K. SONG et al., "Resonant-cavity InGaIn quantum-well blue light-emitting diodes", Applied Physics Letters, Vol. 77, No. 12, 18 September 2000, pp. 1744-1746.	

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